

# FUNDAMENTALS OF GOOD STACKING

*For the*  
**EFFECTIVE AIR  
SEASONING OF  
SOUTHERN PINE  
LUMBER**



**SOUTHERN PINE INSPECTION BUREAU**  
OF THE SOUTHERN PINE ASSOCIATION  
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## Preface

The principal objectives of any system of lumber seasoning are (1) low and uniform moisture content, (2) rapidity in drying time, (3) economy in operating cost and (4) minimum depreciation in grades, including the prevention of stain. Proper seasoning ranks in importance with any other phase of lumber manufacture.

While this has always been so, today there is more reason than ever for the best possible practices to be followed in lumber drying. It is not only true that the grading rules for Southern Pine place definite limitations on moisture content, but higher operating costs necessitate the utmost efficiency in every department. The grade downfall in the seasoning process must be held to the very minimum. When proper stacking methods are followed, all of the objectives of lumber seasoning are met. The manufacturer not only benefits as a result of the higher grade yield, but is placed in a position to fully meet his responsibility to supply properly dried lumber for the construction needs of the nation.

It is recognized that each individual mill will have its own peculiar problems requiring modifications of any general rules that may be formulated for successful drying. Conditions vary with geographic, climatic and local atmospheric conditions. Temperature, relative humidity and circulation of air through the stack govern the rapidity, efficiency and uniformity of drying. Regardless of local conditions, however, air circulation can be controlled to a great extent by proper stacking practices—and circulation undoubtedly is the most important drying factor.

The recommendations contained in this bulletin are a composite of sound stacking methods as observed among mills under the grading supervision of the Southern Pine Inspection Bureau. They might well be regarded as first principles in the technique of good air seasoning and are offered with the thought that they should be of special interest and value to a large number of Southern Pine manufacturers at this particular time.



## The Air Drying Yard

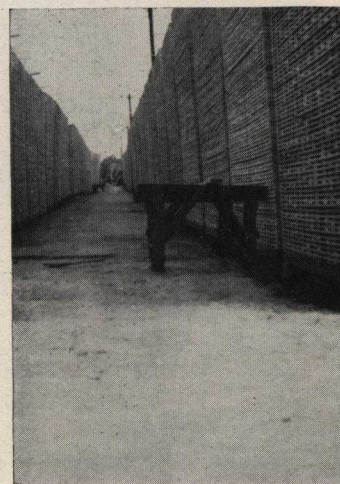
A primary requisite in any air drying lumber yard is good drainage. An ideal site is one of gently rolling terrain or slightly sloping ground. Under no conditions should pools of water be permitted to remain in the yard. When sloping ground is not available, every effort should be made to select a site having sandy soil or an easily drained surface so as to assure the quick absorption and drainage of rainfall and other moisture.

All weeds, vegetation and debris or lumber scraps should be removed and the yard kept constantly clear of all such interferences with the free circulation of air. Weeds and vegetation have the effect of holding moisture in the ground and create a condition favorable to the growth of decay and stain producing fungi. Debris not only retards air circulation but encourages termite attack and contributes to the development and spread of rot spores. A clean yard hastens the drying process and reduces greatly the hazards of stain and decay.

### Main Runs or Alleys

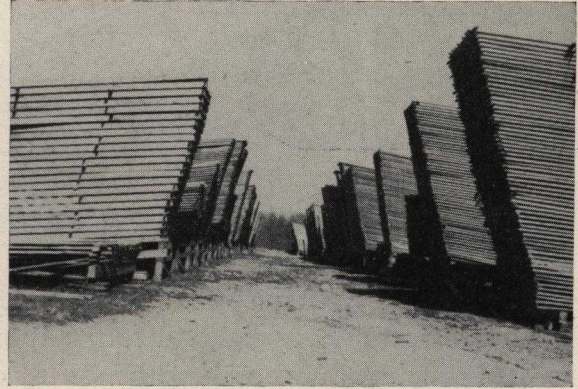
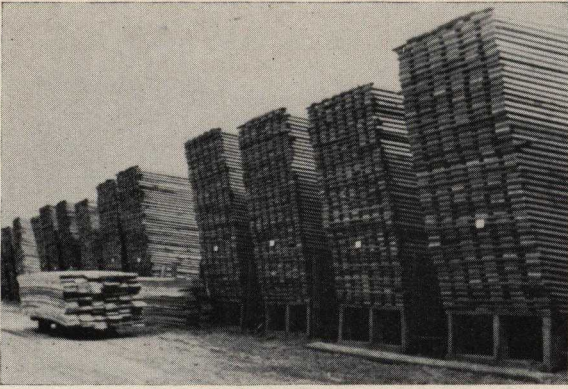
To facilitate economical transportation and make possible the convenient handling and piling of lumber, the main alleys should never be less than 16 feet wide. More often it is found desirable to have them from 20 to 24 feet in width. When the lay of the land and other conditions will permit, the principal alleys should run north and south, with the stacks pointing east and west. This not only affords full benefit of the prevailing winds but permits the sun to have an equal chance at each end of the lumber in the pile, and not concentrate its rays too much on any one part of the lumber.

Aside from facilitating the movement and handling of lumber and aiding air circulation throughout the yard, wide runs or alleys greatly reduce the hazard of fire. In the absence of adequate separating alleys there is always the danger that a small fire, which might otherwise be controlled, may spread throughout the yard and cause a complete loss.



*A well-drained site, looking down a roomy main run or alley.*





*Two views of main alleys which provide ample space for lumber handling and the free play of wind currents.*

## Rear Alleys

It is preferable that rear alleys be 8 feet wide and in no case should the width be less than 6 feet. Because rear alleys are like back streets, they are frequently neglected, obstructed with debris and covered with weeds and vegetation. It is not unusual to find sticker strips and other small stacks of odds and ends scattered helter-skelter in the rear alley.

It is just as important for the rear alley to be kept free of all such matter as it is in any other part of the lumber yard. Any interferences with the free passage of air in the rear alley will greatly offset the benefits which might be gained from otherwise observing correct stacking practices.



*A rear alley like this greatly facilitates drying. It must be kept constantly free of weeds and debris.*



*Everything that should not be done in rear alleys is here illustrated.*



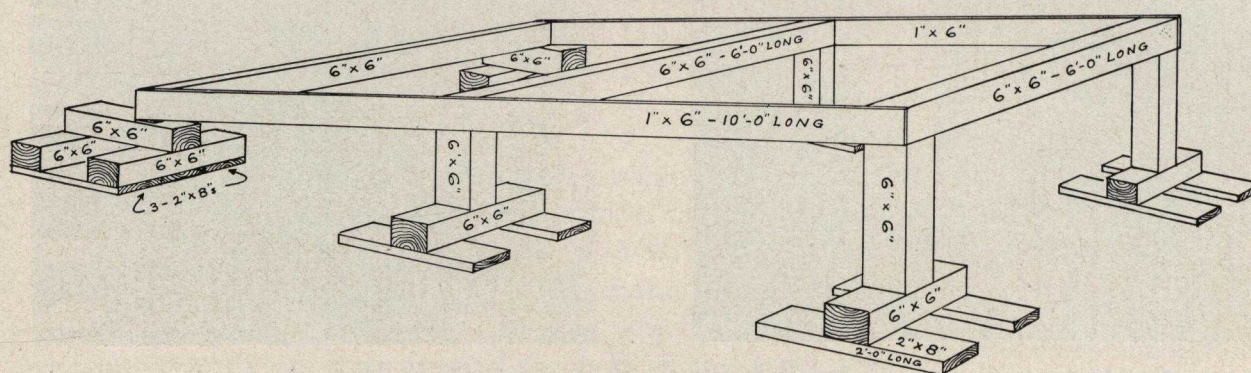
# Stack Foundations

The essential features of an adequate stack foundation are rigidity, durability, ample elevation to permit the free circulation of air through the pile and arrangement taking full advantage at all times of prevailing winds. To accomplish the latter purpose, all foundation forms should be constructed with a view to stacking the lumber lengthwise in an easterly and westerly direction.

The diagram shown on this page illustrates a sturdy and economical stack foundation. It will be noted that the two rear piers are specially constructed, with three 2x8's resting on the ground as an added precaution against sinking. Even better results will follow if 3-inch lumber is used for the bottom. The other piers are made of 6x6's, although 6x8's or 8x8's may just as well be used if they are more readily available. For uprights, log cut-offs would very well do the job.

To assure greater durability, all of the members on or near the ground may be creosoted. If creosoted material is not readily available, the members should at least be constructed of dry lumber and brush treated with creosote. If it is necessary to use green lumber in the construction of the foundation, it is certainly desirable for the bottom side of the pieces resting on the ground, as well as the ends and other parts in contact with other members, to be brush treated. If the lumber is green or only partially seasoned, it is not desirable to brush treat the entire piece because this would have the effect of sealing in the moisture and causing rot to develop.

Each foundation should have a slope of 1-1/4 inches to the foot so that any water accumulating in the stack may quickly drain. The top of the rear sill should be no less than 20 inches from the ground. Beginning at this point, the height should increase toward the front end at the rate of 1-1/4 inches for each foot of length of the foundation.



*Detailed perspective of stack foundation.*



## Foundation Lengths

The length of any foundation naturally depends upon the dimensions of the lumber to be dried. Probably the best arrangement for crosspieces or sills is as follows:

Foundation Lengths	No. of Sills
8 and 10 feet	3
12 and 14 feet	4
16 feet	5
18 and 20 feet	6

There are many manufacturers who regard as adequate three crosspieces or sills, one at each end and one in the center, for 8, 10 and 12-foot foundations and four crosspieces, one at each end and two on split or equal centers, for 14 to 20-foot bottoms or foundations. From the standpoint of providing a more substantial foundation however, and reducing degrades, it is undoubtedly better to use the greater number of sills, with corresponding stickers, as recommended above.

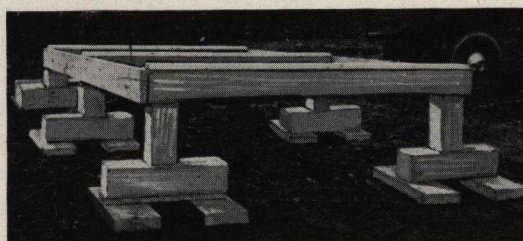
## Foundation Width

The preferable width of a stack foundation is 6 feet, although there is no serious objection to the construction of stacks 8 feet wide. The narrower stack greatly facilitates the drying time and 6 foot forms are recommended not only for this reason but because of economy in securing and convenience of handling stickers.

When 6-foot stickers are used, they are available from the short lengths that normally accumulate at every mill. It is certainly more economical to use these short lengths for this purpose than to attempt to use longer lengths which have a greater market value. The shorter sticker, too, is easier to handle and there is a lesser possibility of breakage.

When wide stacks are used, there is not only less air circulation, which in turn slows up the drying process, but a longer time is required to finish out a stack. In items that accumulate slowly, the pieces that are put on the bottom may dry long before the stack is finished. On the whole, there is a much more rapid turn-over in stock when narrower stacks are used.

The space between stack foundations should be uniform. While the exact space allowed depends upon the yard layout and the amount of space generally that is available, in no case should it be less than 3 feet.



*Only 250 feet of lumber used in this simple and economical 10-foot foundation.*



## How to Stack

The method followed in the actual stacking of the lumber is of vital importance. The time required for completion of the seasoning process, as well as the success attained in maintaining brightness and minimizing grade depreciation, all depend upon the procedure that is followed in this respect. There is no phase of air seasoning that is more important than this.

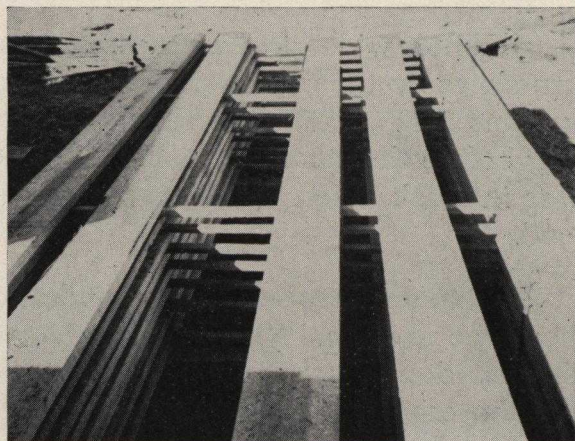
All lumber should be stacked as soon as possible after it is sawed and under no circumstances should more than twelve hours elapse between the time the lumber comes from the saw and is put into the stack. Greater advantages are derived when lumber is stacked immediately after it is sawed for there is then much less likelihood of stain fungi getting the kind of start that invariably results in blued lumber. If lumber is sawed too late in the afternoon to be stacked on the same day, then it should be stacked as early as possible the following morning.

It is probably unnecessary to comment on the desirability of sorting lumber for stacking according to thicknesses, widths and lengths. This not only affords better stacking piles and easy accessibility to the lumber but facilitates inventory taking and affords a marketing advantage by making available specified lengths. In addition, when odd lengths are stacked in a single pile, the overhanging pieces invariably develop crook, warp and twist. From every viewpoint, it is highly desirable that each stack be confined to a single thickness, width and length.

## Spacings

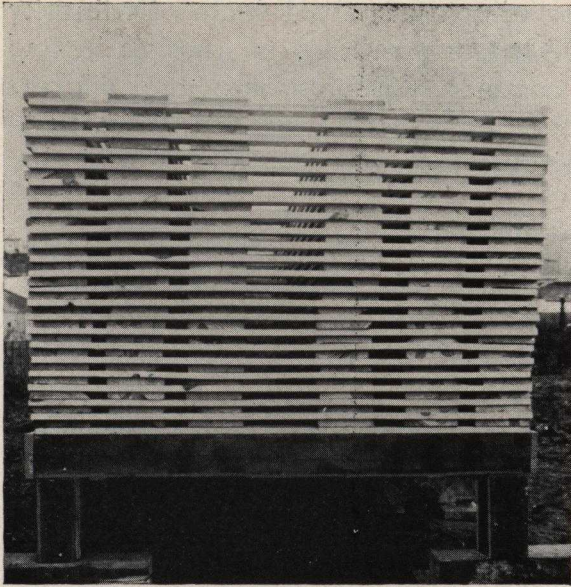
To afford proper air circulation, close attention should be given to the amount of space that is allowed between pieces put on the stack. Where drying conditions are unusually favorable, it is a quite common practice for a 3-inch space to be allowed between pieces in the same course. Regardless of the spacing, each succeeding piece should be stacked exactly above the other to make the tiers as uniform as possible.

Where drying conditions are not so favorable, in addition to the 3-inch space allowed between the pieces in each course, a center flue or chimney may be provided. This is accomplished through the elimination of the center piece from the middle of each pile, in addition to the usual 3 inches allowed. As an example, in stacking 1x4's, the center chimney would be the width of the 1x4, plus the 3 inches allowed on each side, or a total space of 10 inches. The same would hold true with other sizes. In stacking 1x6's,



*Looking down on a "new" lumber stack. Note regularity of spacings.*





*An illustration of the center chimney or flue.*

never exceed 2 inches to the foot. It is seldom desirable for a stack to be over 16 or 18 feet high. From the standpoint of effective drying, there is no advantage to a high stack, and lower stacks are more convenient under the usual methods of handling lumber. If sufficient space is available, a 12 foot stack is the most desirable and economical.

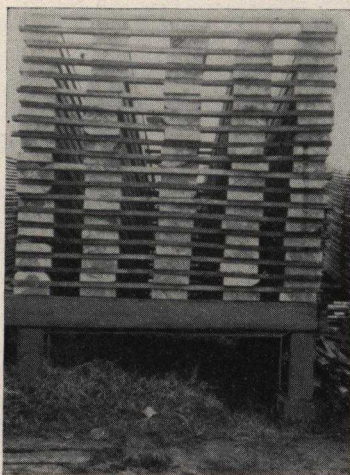
the center chimney would be 6 inches, plus the usual 3 inches on each side, or a total of 12 inches. This provides a complete chimney or flue outlet through the entire center of the stack, enabling air to escape and facilitating freer circulation through the stack.

For best all-around results, wider uniform spaces between the pieces in each course are recommended. This may be best accomplished by leaving a 4-inch space between such pieces when stacking lumber 4 inches wide; 6-inch space for pieces 6 inches in width, and 8-inch space for pieces 8 inches and wider. The center flue or chimney need not be used when this method of spacing is followed.

The pitch of the pile should incline toward the front at least 1 inch to each foot of height. Ordinarily this pitch should

## Stickers

The separating strips or "stickers" should be uniform in thickness, so as to avoid warping, twisting and checking of the lumber. This is important enough to justify working the stickers to S1S, S2S or S4S if necessary to attain the required uniformity. The stickers should always be thoroughly dry.



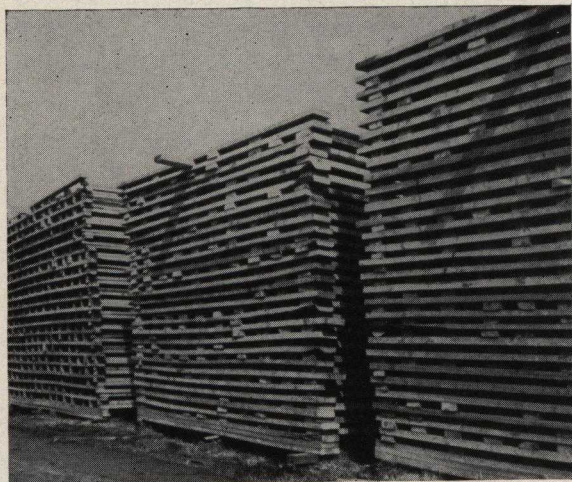
*With wider spacing between pieces the center chimney is unnecessary, and quick, easy drying is assured.*

For 1-inch stock the stickers should be 1 inch thick by 2 inches wide. For stock 2 inches and over, 2x2 stickers should be used. If for any reason it should be regarded necessary to uniformly use stickers 1 inch thick on all thicknesses of stock, then it would certainly be desirable for wider spaces to be allowed between the pieces when stacking lumber 2 inches and thicker.

In placing stickers on each layer of lumber, care should be exercised to see to it that each is uniformly placed above the one on the next lower course, following the pitch of the stack. Where the grade or quality of the lumber justifies extra precautions against deterioration in the form of end-checking, the stickers should be so laid at each end (both front and rear) that they will

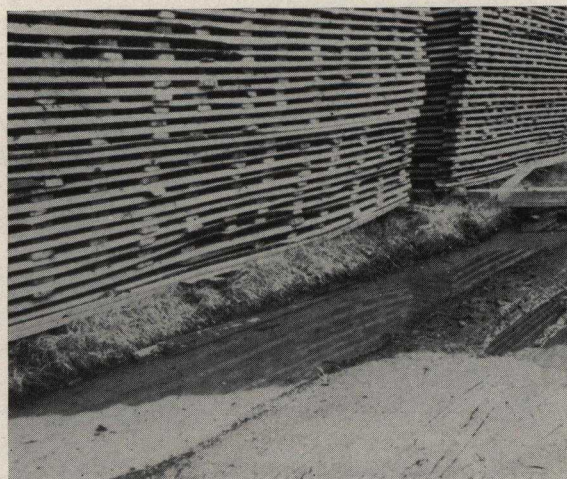


overhang or overlap the ends of the lumber approximately 1 inch. Ordinarily the extra time and effort required to accomplish this overhang or overlap in end stickers is not warranted in the stacking of common yard lumber. End stickers should preferably be placed flush with the front ends of the lumber, keeping in mind that a slight overlap is much more desirable than recessions of any kind.



*A good example of how not to stack. Low foundations—cross stripping with wide green lumber—irregularity of spacings—lack of slope or pitch—all contribute to poor drying conditions.*

*Here there is no foundation whatever, and water stagnates in the ditch alongside the stack. Proper seasoning can never be accomplished in this type of drying yard.*





Very few investments will return as high dividends to the lumber manufacturer as the small additional expense needed for the proper stacking of lumber for air drying. The reduction in grade depreciation from seasoning defects, together with the lower average weights accomplished through proper stacking, may well represent several dollars per thousand feet. With drying time shortened, earlier sale and shipment is possible, which contributes to the lowering of carrying charges.

. . . .

There is no economy in the erection of excessively high or wide stacks; the saving in yard space is greatly offset by the longer time required for drying. Narrow stacks speed up the drying process throughout the stack, make possible a more uniform moisture content, and result in a faster turnover of lumber in the drying yard.

. . . .

There is no more harmful stacking practice than that frequently observed of using pieces of unseasoned lumber as stickers. When piles are self-stickered, degrading is bound to occur due to the several wet places in each piece and in the crosspieces themselves. This not only results in the payment of excess freight on the unnecessary water at the stacking stick contact points but in subsequent shrinkage and checking at these points which leads to claims and dissatisfied customers. The wet spots at crossing points are also the cause of rejection of shipments, for the moisture content limitations of the grading rules are maxima and not averages and accordingly the conformance of a piece of lumber to the requirements of the rules must be determined by the moisture at the wettest place in the piece. The expense of providing and using narrow, seasoned sticks is nil when compared with the losses that are otherwise risked.

. . . .

If trouble is experienced with stain, the spacing between the pieces in each course should be increased. If excessive stain occurs near or in the lower portion of the stack, double the thickness of the stickers in the lower one-third of the pile or increase the space between the pieces in each course. If necessary, raise the foundations or omit pieces in the courses of the lower half so as to form two flues or chimneys instead of one. This facilitates the escape of moist air. An over-all precaution against stain, of course, is the rapidity of handling the lumber from the time the tree is cut until the lumber is properly stacked in the yard.

. . . .

The failure to promptly label stacks frequently contributes to mistakes in the running of lumber containing excessive moisture content. When a stack is finished, the date should be plainly indicated on the stack. There can be no question then as to how long it has been drying. When stacks are broken, no attempt should be made to pile additional lumber on them.



## Appendix

The foregoing recommendations for flat stacking are based upon many years of experience and research in the most effective methods of air seasoning Southern Pine lumber. At the same time it must be recognized that there are other systems in use, such as the practice of end-stacking as followed by some operators, and the practice of cross-racking or end-racking as followed by others. Because of the extent to which end-stacking resembles flat stacking (with stacks turned on end), it possesses distinct advantages over the common methods of end or cross-racking, but neither of these systems are recommended as a satisfactory year-in and year-out method of drying.

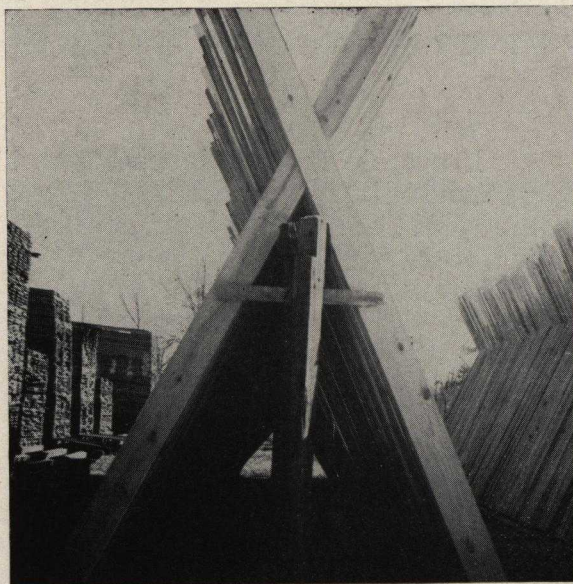
The shortcomings of end-stacking and cross-racking are generally recognized. For one thing, the best results require double handling, for when the lumber has been stacked on end for a period, it should then be flat stacked or bulk piled, if not dressed and shipped immediately. Some who have closely studied this situation recommend that lumber should be cross-racked only for a period of from two days to two weeks, by which time the stock is usually dry enough to prevent blue stain, and then flat stacked to keep warping and checking to a minimum. It has been found, also, that under either method of end-stacking or racking the lumber will dry in the upper portion of the piece more quickly than in the lower due to the closeness of the latter to the ground. This disadvantage can not be overcome by laying boards on the ground for the pieces to rest on, although such a practice is better than having the stacks rest on the ground. Undoubtedly better drying results would follow if the lower portion of boards stacked in this manner were supported a foot or more above the ground, but this is generally regarded as impractical.

Notwithstanding the deficiencies of these systems, they will doubtless continue in use, particularly during times when the pressure of demand makes possible the immediate dressing and shipment of lumber as soon as it is seasoned. The explanations given in this section are offered only with the thought that they may be helpful to those manufacturers who, for reasons of their own, regard it desirable to end-stack or cross-rack their 1 inch lumber.

### Cross or . . End-Racking

There are two methods of cross-racking lumber, one of which is designated as the "X" form and the other the "inverted V." There is usually less warping and checking when the latter form of racking is used, therefore, it is to be preferred. Another advantage of this method is that stain, scantness, etc., is most likely to occur at the points of contact between boards and there is accordingly a smaller loss from trimming if the defect is closer to the end.

There is little that can be said in favor of cross-racking. While it may hasten the drying period under some conditions, uniform moisture content is unattainable, not only because of the invariably higher moisture content in the lower part of the board, but because of the wet places that remain at the points where the boards cross. As indicated before, all moisture content limitations in



*The usual form of cross-racking, of the "X" type. In the "inverted V" type, the boards cross close to the top end.*



grading rules are maximum limitations and not averages, and it is obvious that the moisture content of boards dried in this manner must be judged by the percentage of moisture found at the wettest place in the piece.

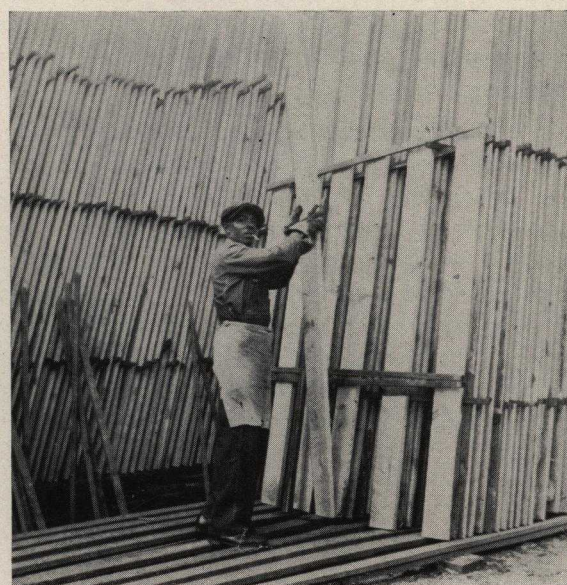
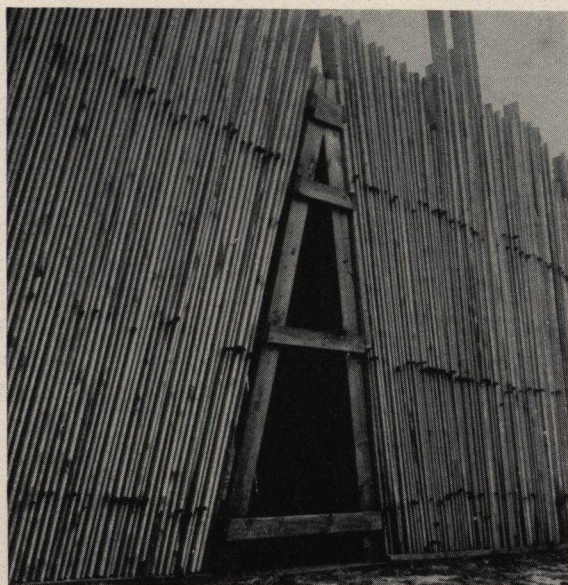
Aside from the lack of uniform moisture content in boards that are dried in this manner, degrading is very likely to occur due to stain, rot, scantness, etc. at the places where the boards cross. The arrangement also requires a great deal of yard space.

## End-Stacking

The deficiency of wet spots which is so pronounced in cross-racked lumber is largely overcome by what is generally termed the "A" system of end-stacking. Here lumber is placed on end against a rack with spaces allowed between the boards in each course and with each course separated from the next by stickers. Just as in flat stacking, care should be taken in placing the stickers so as to minimize warping and checking and in providing proper flues or chimneys in the stack. Usually the ends of the lumber rest upon some boards placed on the ground as a means of minimizing the absorption of ground moisture and facilitating the drying of the lower part of the board. As indicated, however, there is invariably a variation in the moisture content throughout the length of lumber dried in this manner.

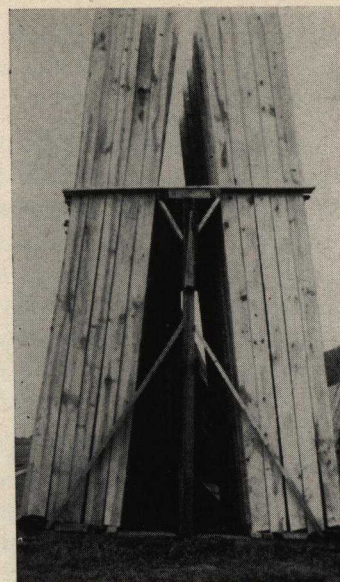
When lumber is end-stacked, it must be promptly dressed and shipped as soon as it is dried for it will otherwise deteriorate rapidly due to warping and twisting. The only other alternative is to tear down the end stacks and put the lumber in bulk piles, but this double handling usually is too costly.

Another method of end-piling, which is somewhat more elaborate than that involved in the usual "A" system, is now being used in an effort to quicken the drying time and yet avoid some of



*Two views of end-stacked lumber, showing construction of center "A" rack and sticker arrangement. The advantage of a well-raised floor is clear.*





*In this type of rack, boards are placed in slot-openings at top, and should rest on a floor.*

the deficiencies of other methods of end-stacking. This involves the erection of a rack to hold the lumber, consisting of braced posts, the height to be determined by the length of the lumber to be stacked. There are cross-arms on the top of the posts, approximately 24 inches in length, on which are placed 2 x 4 or 4 x 4 rails which run from the cross-arm on one post to that of the next. At right angles to these rails 1 x 2 or 1 x 4 lathing is nailed, spaced sufficiently wide to permit the lumber that is to be dried to slide in. The lumber is placed in these slots with one end resting on the ground or floor (some kind of flooring is always desirable). Six pieces of 1 x 6 can be stacked to each side and so each parting strip will accommodate twelve pieces. This stacking rack can be made as long as may be desired.

The advocates of this system claim for it the advantages of fast drying, the absence of stain or stack rot, and lower cost of stacking. It is indicated that five times as much material can be put on this type rack as on an ordinary cross-rack. It is further argued that any number of boards may be removed from the rack without in any manner disturbing those that remain. It is admitted, however, that here, too, the lumber must be removed reasonably soon after it is adequately dry to prevent degrading.

The conclusion is inescapable that many of the claims of faster drying time for end-stacked or cross-racked lumber are based on comparisons with methods of flat stacking that are inadequate. The drying time for flat stacked lumber can be materially reduced through the observance of correct stacking practices as herein outlined, including wide spacings between the pieces in each course. While the initial cost of good stack foundations is greater than the apparent cost of end-stacking or cross-racking, when all of the factors are carefully weighed, there can be but one conclusion, and that is that all of the claimed benefits of the systems of end-stacking and cross-racking can be attained through the observance of sound flat stacking methods. As a matter of fact, there are many distinct additional advantages in approved flat stacking practices which can never be enjoyed under any other method.







